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WEIL-FELIX TEST FOR TYPHUS FEVER.

THE WEIL-FELIX REACTION IN THE DIAGNOSIS OF TYPHUS FEVER AS USED AT THE NEW YORK QUARANTINE STATION.

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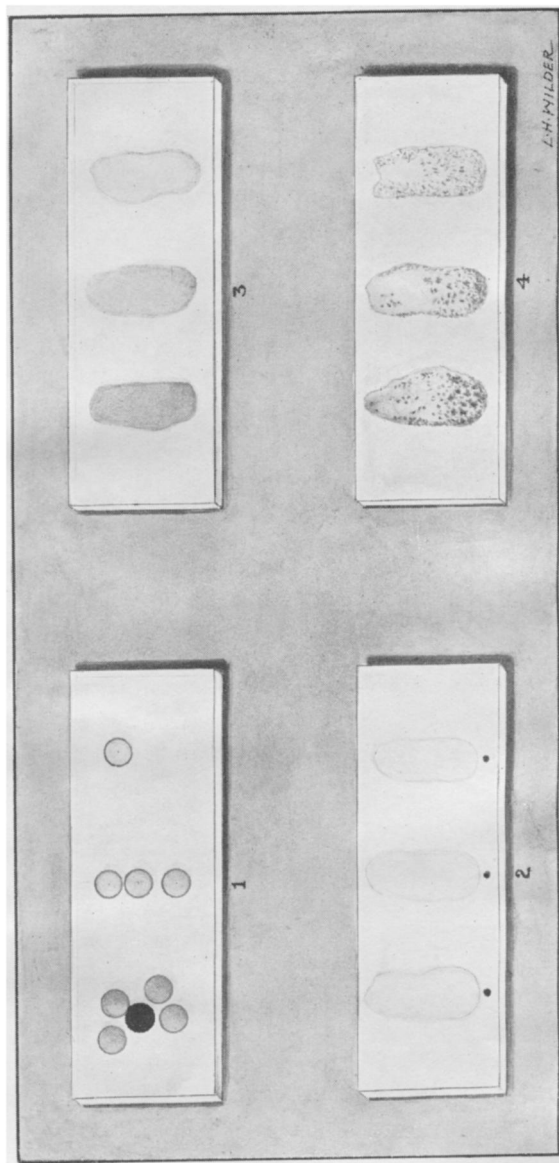
Physicians with experience in maritime quarantine agree that the clinical diagnosis of typhus fever, while frequently difficult, is, some times, impossible, and will welcome a reliable laboratory test for this disease. The Weil-Felix test, first described in 1918, has been in use at the New York quarantine station for more than two years and has given satisfactory results. It has been of great value in deciding obscure cases, thus increasing the protection to the country and shortening the delay to commerce and the traveling public. We believe our experience warrants us in recommending the use of this test in quarantine practice, and elsewhere, when there is a question of typhus fever. We also wish to submit the simple technique worked out in the laboratory at this station.

The Weil-Felix reaction depends upon the agglutinating property of typhus serum upon certain strains of the *Proteus* group isolated in 1915 by Weil and Felix from stool and urine of typhus fever patients, and designated by them X 2 and X 19. The exact nature of this phenomenon need not be discussed for our purposes, nor is it necessary to review the literature. In this work we have used exclusively the strain X 19.

Since February 3, 1920, 1,698 tests have been made at the New York Quarantine Station. Twenty of these tests were made upon clinically positive typhus patients, 43 upon atypical or clinically doubtful cases, 737 upon cases of various acute diseases, 264 upon persons suffering from chronic diseases, and 634 upon apparently normal persons. In all but two of the clinically or atypically positive cases of typhus fever (CP-SH, as shown in the table), the first tests were positive. These two negative tests were made early in the disease, when, as is well known, the reaction is frequently not manifest. Later, both became positive. All cases giving a positive reaction were undoubtedly typhus fever.

We employ as a routine technique at this station, first, a tentative test, which, if positive in dilution $\frac{1}{20}$, is followed by a second or confirmative test. The tentative test is usually made on shipboard as follows: Prick the suspect's ear and touch the resultant drop of blood with a clean glass slide near one end. Allow the blood to coagulate. With a 2 mm. loop, place at the other end of the slide one loopful of normal saline solution, three loopfuls in the center of the slide and four loopfuls near the drop of blood, as shown in the accompanying figure. Mix the blood with the four drops of saline near it, using a wire bent at right angles instead of the loop. Separate the clot and discard it. Carry one loopful from this dilution to the three drops of saline and mix, and carry a loopful to the single drop and mix. Thus, there are obtained three dilutions of serum of approximately $\frac{1}{5}$, $\frac{1}{20}$, $\frac{1}{40}$. The mixing should be done up and down, from edge to edge of the slide, in as narrow a channel as possible in order to conserve the body of the fluid. When this is done, sterilize the loop in the flame of an alcohol lamp, pick up a small amount of the culture X19 from a 24-hour agar slant and place a little at the margin of each dilution. Emulsify first, dilution $\frac{1}{40}$, next $\frac{1}{20}$, and finally $\frac{1}{5}$, going directly from one dilution to the other without flaming the loop. Pick up the slide and rotate it slowly upon its long axis against a dark background. Agglutination is shown by the appearance of white flocculi which increase in size and are readily discernible in the stream of fluid as it flows in its narrow channel across the slide. Prompt and complete clumping, especially in dilutions of $\frac{1}{40}$, points to typhus fever. If no clumping take place within three minutes, add to dilution $\frac{1}{40}$ a small amount of typhus serum as control, or, if typhus serum is not available, add the serum of a rabbit immunized against X19.

Where the tentative test is positive, the patient is bled from the basilic vein and the confirmative test is made in the laboratory as follows: Serum dilutions of $\frac{1}{10}$, $\frac{1}{20}$, $\frac{1}{40}$, etc., to $\frac{1}{2560}$ are made in Wassermann tubes. Nine-tenths c. c. of normal saline solution is placed in the first tube and 0.5 c. c. in each of the other tubes, using a 1 c. c. pipette. Add 0.1 c. c. of the separated serum to the 0.9 c. c. saline of the first tube, using a 0.2 c. c. pipette, thus making a dilution of $\frac{1}{10}$. Successive dilutions of $\frac{1}{20}$, $\frac{1}{40}$, etc., are made by the addition of 0.5 c. c. of a dilution to the succeeding 0.5 c. c. of saline, using the original 1 c. c. pipette until the series is complete. Now, with the same pipette, deliver on glass slides, from right to left as shown in the diagram, a drop of each of three dilutions beginning with the highest dilution, and proceed as in the tentative test. By this method agglutination in dilution $\frac{1}{40}$ may be regarded as diagnostic of typhus fever, and the highest agglutinating titer of the serum is quickly determined.



1. Blood drop with necessary amounts of saline solution for approximate dilutions of 1, 10, 100.
2. Dilutions of 1, 10, 100 with Proteus X 19. Culture below ready to mix.
3. Emulsions showing negative reaction.
4. Emulsions showing positive reaction, 1, 10, 100.

A table is presented herewith showing certain selected cases diagnosed at the New York quarantine station. In general, it may be said that those classed as typical cases would have been diagnosed by our regular clinical methods of examination. However, those classed as atypical might have been admitted unobserved; and, on the other hand, the clinically suspected cases, such as are shown in the third part of the table, if held for observation, would have caused serious delay to the ships, whereas the test immediately excluded typhus fever. Therefore, a diagnosis of typhus fever with us invariably depends upon the Weil-Felix reaction.

TABLE I.
SELECTED TYPICAL POSITIVE CASES.

Group. ¹	Case.	Day of dis- ease when first seen.	Rash.			Injected eyes.	Head- ache.	Nervous symp- toms.	Malaise.	Tem- perature.	Weil-Felix reaction.					
			Pro- nounced.	Obscure.	Unob- served.						Tentative slide test.		Confirmatory tube test.		Subsequent tube test.	
											Day of dis- ease.	Result.	Day of dis- ease.	Result.	Day of dis- ease.	Result.
A	JN.	9				+	+	+		100	9	1/40	15	1/40		
A	AT.	7	+			+	+	+		103	7	1/40	13	1/160		
A	LT.	7	+			+	+	+		103	7	1/20	9	1/40	14	1/320
A	MT.	6	+			+	+	+		104	6	1/40	7	1/320	19	1/640
A	EM.	7	+			+	+	+		103	7	1/40	8	1/640	21	1/320
A	VS.	5	+			+	+	+		103	5	1/5	6	1/40		
A	ZW.	7	+			+	+	+		104	7	1/40	8	1/320		
B	JG.	4	+			+	+	+		105	4	1/20	5	1/40		
B	NS.	6				+	+	+		104	6	1/20	7	1/40		
B	SS.	5	+			+	+	+		100	5	1/40	6	1/640	25	1/640
B	MS-a.	8				+	+	+		103	8	1/40	9	1/320	15	1/1280
B	FB.	5				+	+	+		104	5	1/40	6	1/160	17	1/640
B	EA.	8	+			+	+	+		100	8	1/40	9	1/160	19	1/320
B	B.	8				+	+	+		101	8	1/5	10	1/80	14	1/80
B	MK.	8				+	+	+		102	2	1/40	6	1/160	20	1/640
C	CP.	2	+			+	+	+		104	6	1/40	7	1/320	30	1/1280
C	RT.	6	+			+	+	+								

SELECTED ATYPICAL POSITIVE CASES.

A.	EB-a.	9	.....	.....	+	+	+	+	.....	105	9	1/20	11	1/80	23	1/160	.....
A.	MM.	3	.....	.....	.....	+	+	+	.....	(4)	14	1/40	15	1/320	19	1/10	.....
A.	PG.	14	.....	.....	.....	+	+	+	.....	(4)	14	1/40	15	1/320	21	1/80	.....
A.	IL.	10	.....	.....	.....	+	+	+	.....	103	10	1/40	11	1/320	14	1/320	.....
A.	GP.	6	.....	.....	.....	+	+	+	.....	104	6	1/20	7	1/40	10	1/160	.....
B.	RG.	9	.....	.....	.....	+	+	+	.....	103	9	1/20	9	1/160	13	1/40	15
B.	MS-b.	5	.....	.....	.....	+	+	+	.....	102	5	1/40	6	1/320	17	1/640	.....
B.	FF.	7	.....	.....	.....	+	+	+	.....	102	7	1/40	8	1/320	12	1/640	.....
B.	SH.	3	.....	.....	.....	+	+	+	.....	99	3	.....	3	2 1/5120	.....	.....	.....
B.	YK.	7	.....	.....	.....	+	+	+	.....	104	7	1/5	8	1/10	11	1/160	15
B.	JS.	10	.....	.....	.....	+	+	+	.....	99	10	1/40	11	1/40	17	1/320	.....
B.	EF.	8	.....	.....	.....	+	+	+	.....	104	8	1/20	9	1/40	15	1/80	18

CONCLUSIONS.

1. The Weil-Felix reaction is of great value to confirm or eliminate the diagnosis of typhus fever.
2. For the purpose of maritime quarantine, the modified Weil-Felix reaction test devised at this station is reliable, and greatly expedites shipping when there is a question of typhus fever.
3. At the New York quarantine station a positive Weil-Felix reaction is regarded as diagnostic of typhus fever. After the first few days (3 to 7) of the illness, a negative reaction is accepted as the strongest evidence against this disease.

THE NOTIFIABLE DISEASES.

PREVALENCE DURING 1921 IN CITIES OF 10,000 TO 100,000.

ANTHRAX, CEREBROSPINAL MENINGITIS, DIPHTHERIA, INFULENZA, MALARIA, MEASLES, PELLAGRA, PNEUMONIA (ALL FORMS), POLIOMYELITIS (INFANTILE PARALYSIS), RABIES IN ANIMALS, RABIES IN MAN, SCARLET FEVER, SMALLPOX, TUBERCULOSIS, (ALL FORMS AND PULMONARY), TYPHOID FEVER, AND TYPHUS FEVER—CASES AND DEATHS REPORTED, 1921; INDICATED CASE AND DEATH RATES PER 1,000 POPULATION; FATALITY RATES PER 100 CASES; AND MEDIAN NUMBER OF CASES REPORTED DURING PRECEDING YEARS.

The tables shown on the following pages were compiled from data furnished by the health officers of cities. Requests for information were sent to all cities of the United States having 10,000 population or more. The data for cities having more than 100,000 population were published in the PUBLIC HEALTH REPORTS, volume 37, No. 23, June 9, 1922.

The present article contains reports from cities having between 10,000 and 100,000 population which responded to the request for information. It is believed that practically all cities are included which have records of morbidity from communicable diseases which are of value for statistical purposes.

Estimates of population for dates later than the census of January 1, 1920, are not available. The population figures given in the tables are the preliminary figures furnished by the Bureau of the Census as of January 1, 1920. The case and death rates were computed directly from these figures and are subject to correction when estimates of population for post-censal years are obtainable. As nearly all cities have increased in population since 1920, the rates in most instances are higher than the corrected rates will be.

Medians¹ of the total number of cases reported annually during the years 1914 to 1920 are given for cerebrospinal meningitis, diph-

¹ The median has been defined as the magnitude of the middle item in an array. If the number of cases reported are arranged so that the greatest number reported in any one year is first, the second greatest number is second, and so on, then the number of cases in the center of the array is the median. The following illustration shows the method followed when data for five years are available: In a city reporting 60 cases in 1915, 79 cases in 1916, 71 cases in 1917, 58 cases in 1918, and 53 cases in 1919, the median is 60 cases.